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Editor's Note

Predators and syrup– for many, one word conjures up images of survival-of-the-fittest documentaries, the other quiet weekend breakfasts. Could there possibly be a link between a familiar condiment and the realities of the foodchain? The ecological among us will answer, "Of course."

In this issue learn the role that predators play in the suppression of rodents, one of the primary hosts of zoonotic diseases. Then delve into the magic of teaching ecology through maple sugaring. Small mammals, deer, and insects all indulge in the sweetness of sap; its sugars aid in their winter survival and thus the survival of the predators that feed on them.

Does your landscape or garden need a spring pick-me-up? Then be sure to drop by the IES Spring Plant Sale, being held on the lawn of the Gifford House Visitor and Education Center on May 21st-22nd (10 a.m. - 4 p.m.) and 23rd (11 a.m. - 4 p.m.).

The *IES Newsletter* is published by the Institute of Ecosystem Studies, located at the Mary Flagler Cary Arboretum in Millbrook, New York.

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Weapons of Mouse Destruction?

Many predators require large tracts of undisturbed habitat, making them sensitive to human-induced landscape fragmentation. Their numbers tend to decline as the landscape becomes developed. Ecologists have long documented that predators can have profound effects on prey animal abundance, with small mammals, such as rodents, flourishing in their absence. In a recent *Frontiers in Ecology and the Environment* paper (February, 2004), Institute ecologist Dr. Richard S. Ostfeld and colleague Dr. Robert D. Holt (University of Florida) posit a new role that predators may be playing– the suppression of zoonotic diseases.

Dallas Museum of Art

Gustave Courbet's Fox in the Snow (1860) depicts a predator-prey relationship that may protect human health by suppressing rodents and the diseases they harbor.

Defined as diseases transmitted between vertebrate animals and humans, zoonotic diseases include bubonic plague, Lyme disease, salmonella, and rabies. Disease-carrying animals, called *reservoirs*, infect humans through several pathways: when they are eaten by humans, when they bite humans, or when arthropods that have fed on them, such as mosquitoes or ticks, then feed on a human host. Dr. Ostfeld notes that, "Over 60% of infectious diseases impacting humans are zoonotic in origin and zoonoses are on the rise globally, accounting for over 75% of emerging diseases."

Until recently, zoonotic diseases have not been treated as part of ecological systems. In response to the prevalence of zoonoses, the multidisciplinary field of disease ecology has emerged. It involves the study of any ecological system that includes pathogens and incorporates the complexity of multiple interactions.

Mammals are the most common reservoirs for zoonotic diseases, with rodents leading the pack. The plague (*Yersinia pestis*), Lyme disease (*Borrelia burgdorferi*), Hantavirus pulmonary syndrome and Rocky Mountain spotted fever (*Rickettsia rickettsii*) all owe their spread to the presence of rodents. From an ecological perspective, rodents occupy the middle rung of the food chain. Primarily herbivores, with diets rich in plant matter, they are a food source for vertebrate predators such as fishers, foxes, and owls. Through the act of feeding themselves, predators reduce rodent abundance.

"We know that predators affect prey numbers. If fox are eating mice, there will be fewer mice when fox are present. If mice are a zoonotic disease reservoir, and the human infection escalates with reservoir abundance, habitats with fox present would have a lower incidence of disease," comments Dr. Ostfeld. Knowing that predators consume rodents, and rodents are reservoirs for zoonotic diseases, can we infer that predator presence reduces the risk of human disease transmission? The answer depends on both the disease and the predator in question.

For a predator to reduce human health risks two basic criteria need to be met: human disease transmission must be tied to rodent density and the predator must reduce rodent numbers. While human infection rates often are correlated with reservoir density, the authors outline some notable exceptions. These include pathogens that are limited by factors other than rodent hosts, transmission that is dependent on frequency and not density, and situations where abundant rodent hosts actually prevent vectors from biting humans.

Not all predators are created equal. "Predators that continuously suppress prey are more likely to play a role in also suppressing zoonotic disease- not all predators do this," Dr. Ostfeld explains. Specialist predators, such as weasels, can cause dramatic prey fluctuations called "boom and bust" cycles. Predation activity is tightly linked to a particular prey species. When prey is abundant, predators obtain optimal health and breed vigorously. The preceding generation of predators is then confronted with a decimated prey population. Predator survivorship decreases and prey numbers slowly escalate again. During prey peaks, rodent-borne diseases can thrive.

continued on page 3

Ecology- How Sweet It Is!

by Lori Quillen

There are many pathways to ecological education. Taking a leisurely hike with an observant guide. Watching a pupa metamorphose, day-by-day, into a butterfly. Or, when the days are warm and the nights are cool, tapping sweetness from maple trees.

For over two decades, the Institute of Ecosystem Studies has been offering Maple Sugaring programs. This year, under the guidance of Program Leader Ms. Mary Ford and Education Specialist Mr. Chris Tall, over three hundred local 3rd-12th grade students will become immersed in ecological inquiry while learning the basics of maple sugaring. Volunteer participation is integral to the program's success. This year fifteen people are dedicating their time and energy to maximizing the quality of our students' experience.

As humans, we respond to things that appeal to our senses, making the tongue an excellent pathway to inquiry. Learning that we can fulfill our sweet tooth by boiling sap collected from trees is nothing short of magical for students. Teaching them to make connections between the maple syrup and a tree's ability to harness the sun's energy through photosynthesis is IES ecological education at work.

The program is a doorway to exploring a range of questions, such as why trees produce sugar, what other animals are attracted to sap, and why does the sugar content of sap vary from tree to tree? "We want to encourage students to think about the role that sugar maple trees play in the forest ecosystem. Sugaring is a way to engage students in studying how ecological systems function," Ms. Ford comments.

Lori M. Quillen

Students from Vassar Road School investigate a sap collection bucket with their chaperone.

On an overcast March morning, I abandon my office to observe a maple-sugaring program in action. The fire fills the air with the scent of sweetness and charred wood. Mr. Tall and several volunteers greet 6th grade students from Poughkeepsie Middle School as they arrive at the Institute. Science teacher Rosemary Tanner has been bringing students to the Institute's school programs for almost a decade. "The hands-on experiences offered at IES help clarify scientific concepts and give students an outlet to apply classroom lessons. They are essential to the learning process, " she comments.

The morning begins with a lesson on maple tree identification, which can be tricky in the winter, when trees are best identified by their opposite branches and pointy buds. Trees, we learn, are able to make their own food using a process called photosynthesis. Unique to the plant world (and some forms of bacteria), trees are able to transform carbon dioxide and water into simple sugars by capturing energy from the sun with their leaves. These simple sugars give trees the energy they need to grow and reproduce.

Excess sugar is stored to help trees grow in spring, before they leaf out. In early spring, water rises from tree roots, mixing with the simple sugars stored in the trunk, creating sap. When the days are warm and the nights are cool, sap can be harvested. Many trees produce sap, but trees in the maple genus are the sweetest and preferred for making syrup.

A stand of sugar maple trees, called a sugarbush, is waiting for us to explore on the banks of the Wappinger Creek. Trees tapped for sap production are adorned with numbers and silver lidded buckets. During a demonstration, we learn how sap is extracted. Using a drill, a hole is made in a tree's sapwood and a metal spout, called a spile, is placed in the hole. With gravity's help, sap flows from the tree into the spile and then into the collection bucket.

An eager student lifts the metal lid on one of the buckets and marvels at the clear substance within it. Bits of leaves and several insects, including stoneflies and moths, are swirling about in the fluid. "It looks like we are not the only ones that want sap," he comments. Students are encouraged to taste the liquid and reflect on how this substance, which is 98% water, becomes the thick amber syrup you pour on pancakes.

The transformation from sap to syrup requires a little help from fire. When boiled, water evaporates out, leaving behind a substance that is sweeter and thicker. The boiling process is a time-consuming endeavor. Fire volunteers ensure the process, which involves skimming off impurities and maintaining proper heat, goes smoothly. It takes forty gallons of sap to make one gallon of syrup!

Plants form the base of the food chain, making them especially important to organisms, like humans, that are unable to transform sunlight into food. The students discuss their role in the forest ecosystem after learning that an ecosystem is the interaction of living and nonliving things– including sunlight, animals, nutrients, water, and plants.

During a scavenger hunt, students learn that humans are not alone in their love of sugar. Birds, insects and other mammals are attracted to maple sap. Non-human animals can't boil sap, but they have other methods for condensing its sweetness. Red squirrels, flying squirrels, and deer bite off maple buds that are exposed to the sun. When sap rushes to the surface, the sun's rays evaporate off the water, creating sticky syrup for the animals to lick.

continued on page 3

Did you know that...

- Maple syrup contains balanced sugars, minerals, vitamins and amino acids.
- It takes approximately 40 gallons of sap to make one gallon of syrup.
- The sugar-content of sap averages 2.5%, the sugar content of syrup averages 66.5%.
- A small percentage of a tree's sap is collected each year— the rest is left to help them grow in spring.
- The maple sugaring season lasts 4 to 6 weeks, but sap flow is heaviest for only 10 to 20 days.
- Algonquin Indians discovered how to make syrup, which they called 'sinzibukwud', meaning 'drawn from wood'.

Ecology, *continued from page 2*

The sap buckets collected from the trees are brought to the evaporator, which is heated by the fire. Mr. Tall lifts the cover off a pan of boiling sap and steam billows out into the chilly air. "That is the water leaving the sap," he explains. Students are fascinated that to get syrup from sap, you just remove water, nothing is added. One student comments that she will be calling syrup "super sap sweetness" from here on out.

Data analysis further engages students in scientific inquiry. After collecting sap from the numbered trees, students measure its sugar content using an instrument called a hydrometer. They compare the sugar content of the trees with data collected from previous years and speculate why sap sweetness varies. Is it the water, the soil, the sunlight or trees' genetics? The truth is, scientists still don't have an answer to this question, so there is a lot of room for young investigators.

As the program comes to a close, and we indulge in our maple snack, I feel as if we share a powerful secret. From the sun, to the trees, to the bucket, to the fire, to our mouths– we know the origins of something we eat. And that in addition to giving us shade in the summer, trees can give us sweetness in the winter. ●

THANK YOU VOLUNTEERS!

This year's Maple Sugaring Program was made possible through the generosity and dedication of IES Volunteers. The Institute is grateful for their contribution of one of our most precious resources- time. Thanks are extended to: Ron Andruk, Lorien Bottcher, Linda Clarke, Laura Dachenhausen, Misha Fredericks, Pamela Freeman, Linda Gaines, Walter Gates, Gina Griffin, Barry Haydasz, Theresa Horton, Carolyn Klocker, Heather Roberts, David Runski, Henry Schumacher, Kathy Sparaco, Jamie Tall, David Wanson, Elizabeth Wilkins, and Tesha Zaloga.

IES Saturday Programs: Engage in Ecology

Free to the public, fun for the the whole family!

An Evening Frog Foray ◆ April 24th, 6:30-8:30 p.m.

Have you ever wanted to interpret the evening cacophony that seems to take over ponds in the spring? Whose voices are you hearing and what are they communicating? Join IES Native Plant Gardener and "Maven of Muck" Judy Sullivan as she interprets the night music of frogs on the Institute's grounds. Dress for the weather and be prepared to get a little wet.

Barry Haydasz

Nature's Engineers: Creating Habitat for Others ◆ June 5th, 1:00-3:00 p.m.

Did you know that, through modifying the environment, some animals can have profound effects on other animals living in their neighborhood? By changing the local environment, animals can create, modify, or destroy habitat for other species. Come learn the unique ecological roles filled by habitat modifiers such as beaver and earthworms with Institute Ecologist Dr. Clive G. Jones.

Both programs will meet at the Gifford House Visitor and Education Center, 181 Sharon Turnpike, Millbrook, NY. For more information and/or directions, call 845-677-7600 ext. 317.

Weapons, *continued from page 1*

Drs. Ostfeld and Holt speculate that generalist predators, like foxes, and highly mobile predators, like hawks, are more likely to protect human health. Dietary flexibility lets these animals switch between prey species; when the population of a given prey animal gets too low, they move on to another one. Predator numbers never plummet in response to the decrease of a particular prey species. The end result is a constant reduction in rodent abundance, a stark contrast to the fluctuations elicited by specialist predators.

Drs. Ostfeld and Holt assert the need for more ecological studies investigating zoonotic diseases from an ecological perspective. If predator presence is tied to a decrease in the number of infected reservoir species, it will present a strong argument for paying closer attention to how human-induced environmental change impacts predator survivorship.

Lyme disease is a zoonotic disease where human risk is correlated with rodent host density. White-footed mice are the primary host for the vector species, blacklegged ticks. As white-footed mouse populations increase so does human infection risk. "Understanding what regulates Lyme disease, predicting its spread, and ultimately reducing its transmission to humans, depends on our ability to look at the disease from an ecological perspective. Knowing the players is of limited usefulness unless we also know how they interact with one another. We know predators have a role and are working to more clearly define it," Dr. Ostfeld explains.

By monitoring predator abundance on fragments of land in New York, New Jersey, and Connecticut, his research team is investigating how fragmentation affects predator presence. By examining correlations among predator presence, small mammal abundance, and infected reservoir species they will reveal the role that mammalian predators play in suppressing reservoir species. This information then will be weighed against other factors regulating rodent populations, such as food availability. Dr. Ostfeld comments, "Our goal is expand our knowledge of how ecological communities work while helping to reduce the incidence of disease transmission."

Past research has shown that the percentage of Lyme-infected ticks is higher in small forest fragments (less than 3 acres). Forest fragments of this size also are less likely to house viable populations of mammalian predators. When they drop out of the environment we may be losing an important ally in the fight against Lyme disease and other rodent-borne zoonotic diseases. ●

Judy Sullivan

IES Ecology Day Camp

Reserve your child's space now!

Geared for students entering grades 2-4 and 5-7, IES Ecology Day Camp immerses campers in hands-on ecological exploration. Small session sizes and knowledgeable instructors lead to an intimate and enriching student experience. Nine week-long sessions are offered, running from June 28th to August 23rd. Children perform experiments, hike, create art projects, and learn about ecology from counselors and IES scientists. For registration information, please call the Education Office at 845-677-7600 ext. 316. Students in grades 8-12 can participate as junior counselors, for information about junior counselor positions please call 845-677-7600 ext. 322.

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IES®

Newsletter

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Calendar

CONTINUING EDUCATION

The Continuing Education Program is now accepting spring and summer registrations. For information, or to request a brochure, call 845-677-9643 or visit ww.ecostudies.org/cep.html. Spring and summer semester programs include:

Biology

April 24 (2 Sat.): **Spring Wild Plant ID**

Gardening

April 18 (1 Sun.): **The Basics of Stone Wall Construction**
April 25 (1 Sun.): **Spring Garden Q&A**
May 2 (1 Sun.): **The Edible Gourmet Garden**
May 16 (4 Sun.): **Garden Design II**

Natural Illustration

April 16 (1 Fri.,Sat.,Sun.): **Pen and Ink with Color Washes**

May 29 (1 Sat.,Sun.): **Drawing on Location**

VOLUNTEER EDUCATORS

Are you passionate about the natural world? Do you enjoy working with children? The Institute currently has opportunities for volunteer educators. Transfer a love of ecology to students by assisting an Ecology Field Program. Programs include Plant Power, Watershed Studies, Water Wonders, and Fantastic Forests. Interested? Call Susan Eberth at 854-677-7600 ext. 316. Training is provided.

HOURS

Spring Hours: April 1 - September 31

Public attractions: Mon.-Sat., 9-6, Sun. 1-6; closed public holidays. The greenhouse closes at 3:30 daily. **The Ecology Shop**: Mon.-Fri., 11-5, Sat. 9-5, Sun. 1-5. (*Please note: The shop is closed Mon.-Sat. from 1-1:30.)* ***Free permits are required and are available at the Gifford House Visitor and Education Center until one hour before closing time.***

IES SEMINARS

Free scientific seminars are held at 11 a.m. on Fridays in the auditorium from September until early May.

April 2: **"Paleoecological studies on Hudson River marshes."** Dr. Dorothy Peteet, Lamont-Doherty Earth Observatory of Columbia University.
April 9: **"From elements to herbivores: Phosphorus limitation in freshwater systems."** Dr. Kim Schulz, SUNY ESF.
April 16: **"Fire, logging, old growth, and tests of theories of nitrogen cycling in the White Mountains, New Hampshire."** Dr. Christine Goodale, Cornell University.
April 23: **"Notes from the upper edge of the nutrient spectrum: The ecology of waters in agricultural watersheds."** Dr. John Downing, Iowa State University.

THE ECOLOGY SHOP

New items in The Ecology Shop. Wooden animals handcrafted by the Wichi Indians in Argentina; new items for kids, including wooden toys, kites and crystal growing kits. More arriving each week! Stop in to browse, and ask about our many "green" products. **Senior Citizens Days**: 10% off on Wednesdays.

IES SPRING PLANT SALE!

May 21st, 22nd, & 23rd
Friday & Saturday: 10 a.m. to 4 p.m.
Sunday: 11 a.m. to 4 p.m.

The IES Spring Plant Sale features an array of unique perennial and woody plants- perfect for adding to your garden or landscape! Held on the lawn at the Gifford House Visitor and Education Center, 181 Sharon Turnpike, Millbrook, NY.

GREENHOUSE

The Greenhouse is a year-round tropical plant paradise and a site for controlled environmental research. Managed using integrated pest management, plants thrive in its pesticide-free environment! The greenhouse is open daily until 3:30 p.m. with a free permit (see HOURS).

MEMBERSHIP

Join the Institute of Ecosystem Studies. Benefits include subscription to the IES Newsletter, member's rate for courses and excursions, a 10% discount on IES Ecology Shop purchases, and participation in a reciprocal admissions program. Individual membership: $40; family membership: $50. Call the Development Office at 845-677-7600 ext. 120.

The Institute's Aldo Leopold Society

In addition to receiving the benefits listed above, members of The Aldo Leopold Society are invited guests at spring and fall IES science updates. Call the Development Office at 845-677-7600 ext. 120.

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Tel: 845-677-5343 • Fax: 845-677-5976

Street address: Plant Science Building,
65 Sharon Tpke. (Rte. 44A), Millbrook, NY 12545

... for education, general information and The Ecology Shop:

Institute of Ecosystem Studies
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Box R, Millbrook NY 12545-0178
Tel: 845-677-5359 • Fax: 845-677-6455

The Ecology Shop: 845-677-7600 ext. 309

Street address: Gifford House Visitor and Education Center, 181 Sharon Tpke. (Rte. 44A), Millbrook, NY 12545

... IES website: www.ecostudies.org

For information on current IES public events and attractions, visit: www.ecostudies.org/ThisWeek.html.

For garden tips, visit: www.ecostudies.org/gardens.html.